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## Claims

than 0.01.

- A vertical-cavity device comprising:
- (a) a chip comprising an active semiconductor layer for5 providing optical gain;
  - (b) a first mirror arranged on a first side of the active layer;
  - (c) a second mirror arranged on a second side of the active layer, opposite to the first mirror, and forming
- owith at least the first mirror an optically resonant cavity that passes through the active layer in a direction out of the plane of the active layer;
  - (d) a heatspreader for removing heat from the active layer, the heatspreader being arranged inside the cavity
- and having a first surface adjacent to the chip and a second surface opposite to the first surface, the heatspreader being transparent to light of wavelengths in an operating bandwidth of the device;
- characterised in that, in addition to removing heat from 20 the active layer, the heatspreader also has one or more further selected property that has a further selected effect on light output from the device.
  - 2. A device as claimed in claim 1, in which the heatspreader is birefringent and the further selected
- 25 effect is on the polarisation of the output light.

  3. A device as claimed in claim 2, in which the difference Δn between the refractive indices of the heatspreader's slow and fast polarisation axes is greater
- 30 4. A device as claimed in claim 2 or claim 3, comprising a further element that limits the output light to a linear polarisation.
  - 5. A device as claimed in any of claims 1 to 4, in which the heatspreader has a nonlinear optical response.

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- 6. A device as claimed in any preceding claim, in which the shape of the heatspreader provides the further selected effect.
- 7. A device as claimed in claim 6, in which the second surface of the heatspreader is curved or includes a curved structure.
  - 8. A device as claimed in any preceding claim, in which the heatspreader focuses or defocuses the output light.
- 9. A device as claimed in any preceding claim, in which 10 the heatspreader focuses pump light into the active layer.
  - 10. A device as claimed in any preceding claim, in which the further selected effect is on light generated in the active semiconductor layer at a fundamental frequency of
- 15 the device.
  - 11. A device as claimed in any preceding claim, in which the selected property of the heatspreader has been selected to affect the spectrum of the output light.
  - 12. A device as claimed in claim 11, in which the
- 20 heatspreader has a refractive index that has been selected to provide substantially no refractive index step at the first surface.
  - 13. A device as claimed in claim 12, in which reflectance at the first surface of the heatspreader is
- 25 less than 5%.
  - 14. A device as claimed in claim 10, in which the heatspreader has a refractive index that has been selected to provide a refractive index step at the first surface.
- 30 15. A device as claimed in any preceding claim, in which the second surface of the heatspreader is at an angle to the layers of the chip.

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- 16. A device as claimed in any preceding claim, in which the heatspreader has a shape selected to provide control of a spatial mode of the output light.
- 17. A device as claimed in claim 16, in which the
- 5 heatspreader focuses or defocuses intracavity light.
  - 18. A device as claimed in claim 17, in which the second mirror is flat.
  - 19. A device as claimed in claim 18 in which the second mirror is a MEMS mirror.
- 10 20. A device as claimed in any preceding claim, in which the second surface of the heatspreader has a dielectric coating.
  - 21. A device as claimed in claim 20, in which the dielectric coating is an anti-reflection coating.
- 15 22. A device as claimed in claim 20, in which the dielectric coating is a mirror coating and it forms the second mirror.
  - 23. A device as claimed in any preceding claim in which the heatspreader has a thickness of less than 1.5  $\,\mathrm{mm}$ .
- 20 24. A device as claimed in any preceding claim, in which the heatspreader is also a loss modulator.
  - 25. A method of manufacturing a vertical-cavity device, comprising:
  - (a) fabricating a chip comprising an active semiconductor layer for providing optical gain;
  - (b) providing a first mirror on a first side of the active layer;

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- (c) providing a second mirror on a second side of the active layer, opposite to the first mirror, which forms
- with at least the first mirror an optically resonant cavity that passes through the active layer in a direction out of the plane of the active layer;
  - (d) providing in the cavity a heatspreader for removing heat from the active layer, the heatspreader having a

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first surface adjacent to the chip and a second surface opposite to the first surface, the heatspreader being transparent to light of wavelengths in the operating bandwidth of the device;

- characterised in that the method also includes the step of selecting one or more property of the heatspreader to have a selected effect on the output light, in addition to the effects of removing heat from the active layer.
- 26. A method as claimed in claim 25, including the step of forming the second surface of the heatspreader to be 10 curved or to include a curved structure.
  - 27. A method as claimed in claim 26, in which the curved surface is formed by polishing.
- A method as claimed in claim 26, in which the curved surface or the curved structure is formed by etching. 15
  - 29. A device manufactured by a method according to any of claims 25 to 28.
  - 30. An amplifier or laser including a source of pump light comprising a device according to any of claims 1 to 24.
  - 31. An amplifier or laser as claimed in claim 30 that is a Raman amplifier.
  - 32. A vertical cavity device comprising:

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- (a) a chip comprising an active semiconductor layer for providing optical gain; 25
  - (b) a first mirror arranged on a first side of the active layer suitable for forming with at least a second mirror arranged on a second side of the active layer, opposite to the first mirror, an optically resonant
- cavity that passes through the active layer in a direction out of the plane of the active layer; and (c) a heatspreader for removing heat from the active layer, having a first surface adjacent to the active layer and a second surface opposite to the first surface,

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the heatspreader being transparent to light of
wavelengths in an operating bandwidth of the device;
characterised in that, in addition to removing heat
from the active layer, the heatspreader also has one or
more further selected property that has a further
selected effect on light output from the device.